RESPONSE TO QUESTIONS RAISED BY THE NRCA IN RESPECT OF THE PROPOSED DEVELOPMENT AT LONG MOUNTAIN, ST. ANDREW

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Submitted to
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SECTION 1:

Geology & Hydrogeology

EXECUTIVE SUMMARY

Selective Homes Developments Limited proposes to construct on approximately sixty acres of lands located adjacent the Beverly Hills community and southwest the Long Mountain Ridge. The development will include the following:

- Four hundred and sixty two (462) two bedroom townhouses
- Sixty studios
- Forty five three bedroom individual family homes

The proposed development has a density of 27.1 habitable rooms per acre with approximately 14.34 acres of lands being allocated for green and open space, of which six (6) acres is slated as a nature reserve/bird sanctuary.

This report provides answers to questions raised by the Natural Resources Conservation Authority (NRCA), see Appendix 1 for letter dated May 5, 2000, ref. No. 41/2/S3.

Section one reports on the geological and hydro-geological concerns of the development in terms of the specific comments raised by the NRCA. The geological review has indicated that the site is well suited for the Long Mountain Housing Development for residential purposes. The hard micritic Newport limestone, which floors the entire site, will provide a very stable base for construction. The assessment of the area shows that there is no threat of natural disaster that could preclude the development. It should be noted that the proposed development will utilize a central sewage disposal system and paved storm drains. The potential for contamination of groundwater due to the proposed development is negligible.

Section two provides additional information on the biological features of the development and has indicated the presents of ninety species of mostly woody plants, trees, shrubs and some monocots were identified for the site. Of these, 15 species are Jamaican endemic, one of which is endemic to the Long Mountain. Section two also outlines the steps that should be taken in the

preservation and conservation of trees and other plants present within the area. A detail list of those species identified is also included.

Section three provides the plans for the development in regards to the Landscaping activities that are being proposed for the site. This plan outlines the tree preservation and protective measures to be undertaken during the construction period. The end result of the entire plan is the creation of the ***Nature Reserve and Bird Sanctuary*** within the development.

Appendix 2 provides the list of all the drawings that accompany the report, these includes drawings on the infrastructures and housing units.

1.0 INTRODUCTION

This reports examines the sustainability of the Long Mountain Housing Development within a framework of the geological, and topographical aspects of the proposed site, as they relate to:

- wastewater, runoff and drainage
- ground water resources
- excavations

It provides information on the nature of each element and suggest mitigatory measures necessary to ensure a development with minimum levels of adverse impact on the environment.

1.1.0 GENERAL

The area under review is part of an uplifted section of The Wagwater Sequence, which forms a southeast/northwest trending limestone mountain, namely the Long Mountain. The proposed development site occupies the central part of the hill and is situated due south of the very high scale development known as Beverley Hills. It is at least for the time being, most accessible from the end of one of the main streets in Beverley Hills, Montclaire Drive. This will remain so until the main access road leading directly from Karachi, traversing the northeastern flank of the mountain, is completed.

1.1.1 TOPOGRAPHY & DRAINAGE

The area rises very steeply from the west i.e. along Mountain View Avenue, to a height in excess of 1450 feet above sea level and then grades in a much gentler manner to the northeast, where it adjoins the Karachi, Mona and the University of the West Indies properties. The Long Mountain Housing development begins at a {point in the northwest which is approximately 700 ft. above sea level, extends and broadens towards the southeast along a ridge which climbs somewhat gently to a point just over 1250 feet.For the most part the development is confined to the western section of the "catchment or surface water divide" of the area, ensuring maximum natural run off to the west and south west, away from the direction of the Mona Resovoir. There is a small portion of project area which faces the northern part of the divide.

The entire area for development is floored by a very hard micritic limestone, with a well-developed honeycomb and jagged surface on which is developed a vegetative cover consisting of fairly dense to dense semi-desert shrubs. It is interspersed with small gently sloping or nearly flat-bottomed depressions floored by red terra rossa /lateric soil.

The largest of these depressions identified in the area is situated near the northernmost point of the development, and apparently constitutes the major natural soak away system for the area. On the development plan this area is identified as being reserved for recreation.

Natural drainage features are not obvious on the immediate area earmarked for development, since the karstic nature of the surface limestone would suggest that natural rainfall flows would be accommodated by sinkholes, fissures, and solution cavities to form an underground flow away system.

1.1.2 GEOLOGY (Figure 1)

The limestone covering the Long Mountain Housing Development site is of the Newport Formation, which is classically described as a bioclastic/micritic limestone, which at this horizon is, slightly case hardened and partially recrystallized. The Newport Formation is conformably underlain by other members of the White Limestone Group namely, the Walderston/Brownstown Member and the Troy limestone, both of which outcrop only in the nearby Beverly Hills and the Karachi areas respectively, to the north. The entire package of white limestone constituting the Long Mountain, forms the most westerly outcrops of the Wagwater Group, trough formation and is thus underlain by a wide assortment of Eocene and Cretaceous sedimentary and volcanic rocks.

The Long Mountain itself is almost completely surrounded by the loose sediments of the Liguanea gravels.

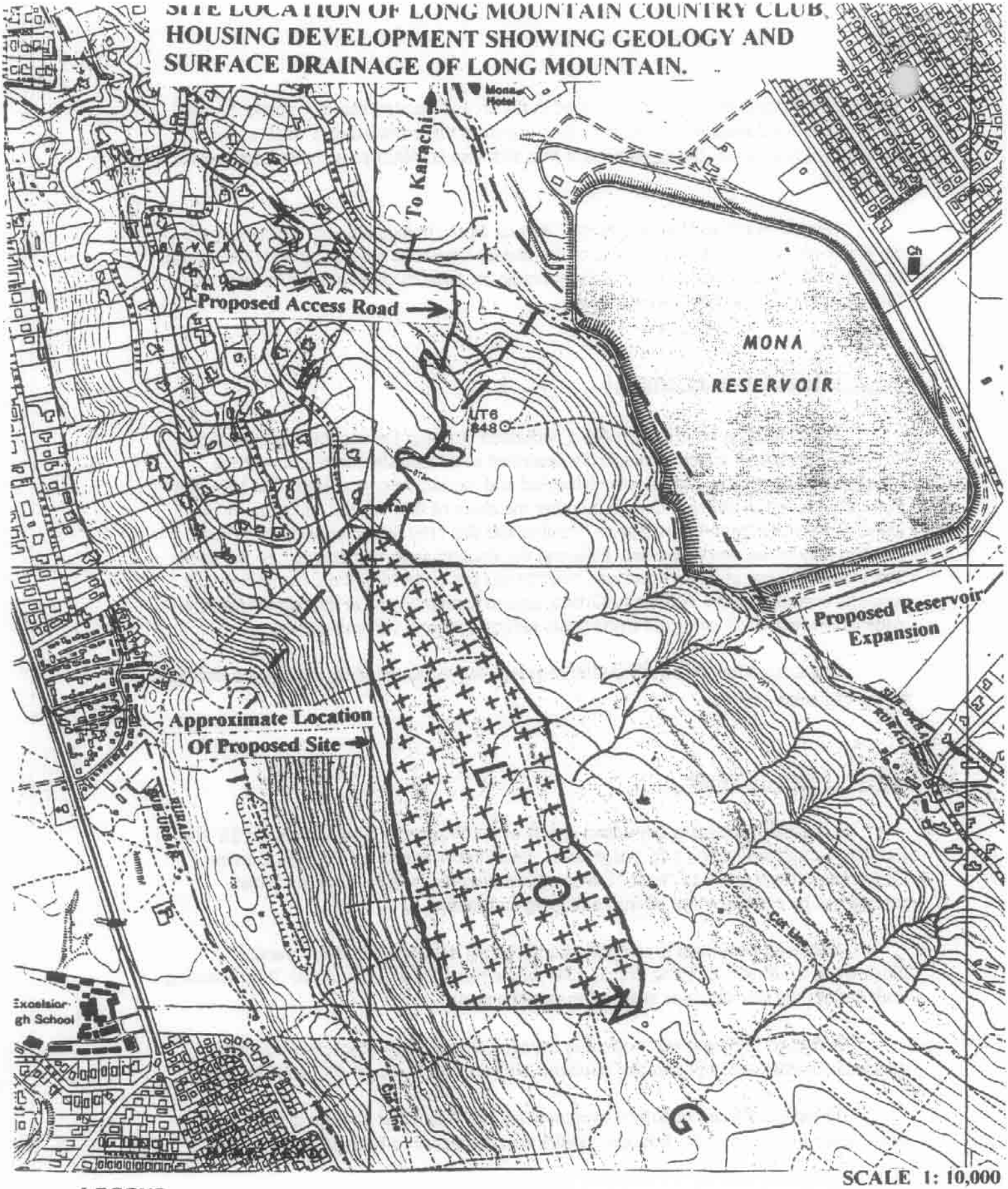
1.1.3 STRUCTURE

Regionally, the Long Mountain is part of the Wagwater Belt, which is a SE-NW trending trough defined by two major faults, the Wagwater and the Plantain Garden. This area is described as an "area of major down warping" which is characterised throughout by extensive and intensive faulting and folding.

The Long Mountain is an uplifted unit (horst) defined by two sub parallel Northwest- Southeast trending faults. One minor North East South South West trending fault defines the development area to the extreme north.

Although folding is not evident in the area, the geology suggests a truncated synclinal structure plunging to the southeast with an overall dip of about 40 degrees.

There is sufficient historical evidence that the Wagwater Trough is earthquake prone since the two primary boundary faults are considered to be seismically active.


SITE LOCATION OF LONG MOUNTAIN COUNTRY CLUB HOUSING DEVELOPMENT SHOWING GEOLOGY AND SURFACE DRAINAGE OF LONG MOUNTAIN.
To Karachi
Mona Hotel
Proposed Access Road
MONA RESERVOIR
Proposed Reservoir Expansion
Approximate Location Of Proposed Site
Excelsior gh School
SCALE 1: 10,000
LEGEND:
Newport Limestone
Geological Fault
Walderston – Browns Town Fm.

There are indications of some movement along the faulted northern boundary of the study area, where the rocks are highly shattered, yielding a loose agglomeratic mass with fragments of primary limestone embedded in a finer grained, grounded limestone matrix. The absence of any sedimentary feature throughout the many outcrops; the presence of slickenslides, etc., and the similarity of this fractured horizon across geologic boundaries, confirm that this material is as a result of tectonic movements rather than by sedimentary processes.

1.1.4 LITHOLOGY

Lithologically the entire development site is underlain by this massive compact micritic partially recrystallized limestone, which is extremely hard and competent, but some degree of brecciation is noted within the region of faults. Recent observations of the area since the beginning of excavation have revealed that incipient jointing is also fairly well developed here in the Newport Limestone.

1.1.5 HAZARDS (Potential)

From a natural hazard point of view, the area earmarked for construction is relatively stable, and so the development should experience no exposure to flooding or landslide hazards during or after construction.

The Wagwater Belt, of which this site is a part, is regarded as being seismically active. This means that the area is prone to earthquakes of varying magnitudes. The entire building construction portion of the development, will be located well away from the margins of the identified faults and will be constructed on firm bedrock. This means that if the construction is done in accordance with the existing building code, no serious adverse effect is expected on buildings in the area. The same cannot be said of the proposed linear features, the access road and the sewer and water pipes which will parallel this road. These systems will transect the northern boundary fault and intersect the vulnerable rubble zone. The road engineering should take this into the design, whilst care should be taken that the pipelines are constructed "with a sufficient measure of play" to accommodate anticipated distensions, resulting from some degree of displacement in the event of an earthquake.

1.2.0 IMPACT OF SEWERAGE TREATMENT AND DISPOSAL SYSTEMS

The proposed method of sewage disposal for Long Mountain Country Club Housing Development is a central sewage system. Sewerage is to be gravity fed from the development to a lift station, where the effluent will be pumped to the Pine of Karachi subdivision

1.2.1 Possible Negative Impacts

Leakage of sewage effluent into the groundwater system can occur, particularly along connecting joints of sewerage pipes at manholes. Although leaks are checked from time to time, undetected leakages can seep into the groundwater system causing contamination of the wells. If sewage seeps to the surface due to blockage of sewer lines, there is the possibility of sewage outflows incorporated into run-off resulting in discharge into the reservoir.

Dynamic loading due to seismic activity can also cause partial dislocation of sewerage pipes along joints leading to severe leakage.

The technical information provided for the method of sewage disposal together with the design plans submitted, suggest that careful engineering planning was carried out to ensure that the system is safe from leakages and ground water contamination.

1.2.2 Mitigation Measures.

Careful monitoring and supervision during the construction phase of the sewage disposal system is critical, particular in relation to the installation of the sewer pipes and fittings. Backfilling should be sufficient to hold the pipes and fittings in place to prevent failure under earthquake conditions and if multiple lines are used in the trenches, then these should be separated with suitable fill.

The PVC and DI pipes are designed to withstand sufficient bending from earthquake loads without failure; however the sewage disposal system should be designed to accept dynamic loads recommended by the CUBIC code (1985).

A monitoring and maintenance programme for the sewage disposal system should be performed during post development phase in order that field checks and corrective work can be carried out on the installation.

1.3 DRAINAGE/RUNOFF IMPACT

1.3.1 Surface Drainage

An estimated 80 to 85 percent of the development is proposed to be located on the south-west facing slope overlooking Mountain View Avenue. The other 15 to 20 percent is situated on top of the ridge and on the upper section of the north east facing slope overlooking the Mona reservoir and proposed reservoir expansion site. The access road from Karachi leading to the Long Mountain Country Club Housing Development is also on the north east facing slope at some distance behind the reservoir.

Surface drainage on the southwestern slope is absent due to the presence of highly permeable limestone with solution features and micro fractures. On the north east slope, surface drainage is visible on its lower section due mainly to the presence of inorganic sediments (silt and clay) in the fractured rock which significantly reduces its mass permeability.

1.3.2 Impact of Proposed Storm Water Drainage)

From the drainage plan provided for the development, storm water run-off is designed to take excess flows on to the northeastern and southwestern slopes of Long Mountain

1.3.2.1 South West Facing Slope

There are seven (7) storm water outlets located at regular intervals on the southwest facing slope to take run-off from the development. Depending on the amount of excess storm water discharge during post development stage, run-off can either enter the groundwater system or find its way along the foot of the slope near Mountain View Avenue. During normal or moderate rainfall, most or all storm water discharge will percolate into the micro fractures and sinkholes on the south west facing slope and act as recharge for the ground water system. When there is very high storm water run-off consistent with intense rainfall, excess storm water will flow to the foot of the slope carrying occasional rock debris and other loose material from construction waste. This situation is however, likely to improve with increased vegetation cover in the development over time.

1.3.2.1 North East Facing Slope

From the drainage design plans, there are eight (8) outlets for storm water discharge on the northeastern slope overlooking the Mona Reservoir. A significant volume of run-off will percolate into the solution cavities of the rock on the upper slope during normal rainfall. However, it is expected that during intense rainfall periods, excess run-off will flow into the narrow gullies which drain the lower slope overlooking the Mona Reservoir. The rock on the lower slope is highly fractured and erodable, and this may lead to rock debris, sediments and pollutants being incorporated into drainage channels and eventually enter the Mona reservoir. Excess storm water from the development will also impact negatively on proposed reservoir expansion site.

Although the design for storm water drainage adequately reduces the high concentration of run-off on the slopes, the estimated 50 per cent increase in run-off rate during post-development stage will provide additional discharge during intense rainfall into three (3) existing gullies which drain the slope directly overlooking the Mona reservoir.

The heavy rains which fell during the passing of hurricane Mitch in November 1998, caused storm water drainage laden with sediments and other pollutants to enter the Mona reservoir from the gullies and the limestone quarry located behind the reservoir near the foot of the slope.

1.3.4 Mitigation Measures

With respect to storm water drainage, there are concerns for run-off on both sides of the slopes. The major concern is the negative impact that storm water discharge could have on the Mona Reservoir and proposed reservoir expansion site.

An estimated 50 to 55 percent of storm water run-off is designed to be released on the north east facing slope towards communities such as Mona Commons and August Town. Surface runoff from these slopes is channeled into the August Town Gully. Peak flows in th August Town Gully is known to cause flooding problms in the August Town Community. The increas surface runoff as a consequence of the proposed development is not significant compared to the overall runoff generated from the total area ontributing runoff to this gully. **An increased risk of flooding in these areas is therefore not a major concern.**

However to prevent sediment laden discharge and other pollutants (oil, garbage) into the reservoir, during excessive storm water discharge, drainage interceptors such as cut-off drains could be constructed at the foot of the slope along the south western side of the reservoir. The cut-off trench should be so designed to allow storm water from the proposed development to be collected into the interceptor drain before entering the reservoir and then channeled into the August Town Gully nearby. This drain should be carefully monitored and properly maintained.

The remaining fifty (50) percent of the runoff generated from the site will flow down the southwestern slopes of the Long Mountain towards commuities such as Hampstead, Mountain Terrace and Mountain View Avenue. Storm water drainage is always a concern for these residents. There is a risk of localized flooding in these areas as a consequence of the proposed development. One method of mitigation is the design and construction of a rock berm at the foot of the hill to control the movement of rock debris and to allow the energy flow of storm water to dissipate from the hillside. Further drains/gullies receiving runoff from these slopes and passing through these communities should be cleaned and maintanined on a regular basis.

Note:- the proposed access road to the development is not considered in the drainage plans for releasing excess run-off. However, some storm water drainage will be expected to flow along the roadway. This can be controlled easily by the use of curb walls and cambering of the roadway.

1.4 GROUND WATER RESOURCES

The limestone formations underlying the site functions as an aquifer - Long Mountain Limestone Aquifer. The aquifer safe yield is estimated at 7.3 million cubic meters per annum (Water Resources Development Master Plan 1990). There are four wells operated by the National Water Commission, that abstract groundwater from this aquifer, with a combined abstraction rate of 8.2 million cubic meters per annum.

The present level of abstraction exceeds the aquifer safe yield and therefore it is unlikely that there will be additional groundwater development in this aquifer. The present level of abstraction has caused deterioration in groundwater quality due to saline upconing, resulting in elevated level of sodium and chloride in the wells.

The use of absorption pits in existing housing development on the Long Mountain ridge have also resulted in the contamination of the aquifer by sewage, as shown elevated levels of nitrate in the wells.

The proposed development will utilize a central sewage disposal system and paved storm drains. The potential for contamination of groundwater due the proposed housing development is negligible.

Mitigation

No subsurace disposal of sewage or storm water should be introduced in the general area.

1.5 EXCAVATION METHODOLOGY

All foundations within the curtilage of the development, for the construction of internal roadways, buildings, sewer mains etc will be located in the extremely hard competent and resistant Newport Limestone. As is pointed out however the area is characterised by shear zones and incipient jointing which will facilitate reasonable levels of exacavation without blasting.

Extensive blasting especially in the northern area of the development site could cause vibrations and noise nuisance in the community of Beverley Hills. Such activity must be avoided. The nature of the host rocks however suggests that locally, jointing and shearing may be closed or are so far apart that excavation by ripping only, could prove extremely time consuming and costly. In such case, and especially in the case of man hole access, limited and very controlled blasting could be allowed, if only to open up joints and closed fractures. Solid boulders which are too large for moving and handling and which cannot be broken by impact might also require controlled blasting to manageable sizes. Such controlled blasting within the confines of the development

boundary will have no negative impact on the surrounding environment, and especially the National Water Commission facilities which are well removed from this site.

In the construction of the access road and attending features, the situation is cause for just slightly greater concern, since this development is on the northern slope of the moutain, within closer proximity to the Mona Resovoir and adjoining facilities, as well as to the Beverley Hills community. Vibrations from any large scale blasting during excavation of rocks in this area could have negative effects:

- **damage to existing buildings**
- **noise nuisance**
- **slope movement in the unconsolidated rock formation**
- **risk to the integrity of the resevoir**

There are indication that cut and fill operation during the road construction could require the removal of in some cases up to three meters of rock in some locations. Removal of such top rocks, by ripping could prove almost futile if some amount of detonation is not permitted.

1.5.1 Mitigating Measures

By large excavation both within the development area, and for the access road should be undertaken by the ripping technique. But very limited and localised blasting may be allowed for the purpose of facilating quicker and more economic construction.

Greater care should be taken when this restricted blasting is being done on the northern flanks for the consturction of roads and related features.

1.6 CONCLUSION AND RECOMMENDATION

From a topographic and general geological point of view the site area under review is well suited for the Long Mountain Housing Development the residential purpose. The hard micritic Newport limestone, which floors the entire site, will provide a very stable base for construction. The bearing capacity of this rock is estimated which iis estimated to be greater than 10.000 Kpa based on the Comonwealth Scientific Research Organisation (CSIR) rating (Bieniawski, 1974) and the Rock Mass Rating (RMR) is 85, classiefies it and falls in the range of "very good quality rock mass" for civil engineering purposes.

SECTION 2:

Botanical Survey for Long Mountain Housing Development

The assessment of the area shows that there is no threat of natural disaster which could preclude the Development. Further, although there are some negative aspects to the development with respect to:

- Sewerage treatment and disposal systems
- Drainage and runoff impacts
- Ground water resources
- Excavation during construction

the study identifies mitigation measures to counteract possible adverse effects.

These include:

- the institution of close monitoring and supervision of the sewerage disposal system during construction and a rigid monitoring and maintenance programme after construction to, ensure that there is no leakage of the effluent into the ground water system.
- the construction of drainage interceptors at the foot of the northen slope to prevent sediment and pollutant laden discharge entering the Mona Resevoir during periods ofexcessive storm water runoff. Similarly the construction of a rock berm at the foot of the southwestern slope will control the movement of rock debris as well as reduce the energy of storm water runoff, and reduce the adverse effects of flooding on the communities along Mountain View Avenue.
- Care should be taken to avoid the introduction of sewage and or storm water int the ground water.
- Excavation throughout should be undertaken largly by the ripping technique. Where blasting becomes necessary this should be very subdued, restricted and highly controlled.

BOTANICAL SURVEY FOR THE LONG MOUNTAIN HOUSING DEVELOPMENT AS PROPOSED BY SELECTIVE HOMES DEVELOPMENTS LTD

Prepared by Andreas Oberli, National Arboretum Foundation, September 2000

1 TERMS OF REFERENCE

The consultant has been requested to conduct a botanical survey of a land area on Long Mountain proposed for housing development and to prepare a report on its plant life, supplementary to the Environmental Impact Assessment of the Proposed Development of Mona Estates and Beverly Hills, St. Andrew prepared by Call Associates Consultancy Ltd. in 1999, which included the same area.

2 METHODOLOGY

The consultant was familiar with the area from several visits between 1989 and 1992. In August and September 2000, the site was visited on seven days. The survey included open areas on the property itself, survey lines through the site, the woodlands surrounding the property, and the higher elevations of an area of a planned access road through forest land controlled by the National Water Commission.

Species identification took place on site and in some instances, vegetative material was collected for identification or verification at the herbaria of the University of the West Indies and the Institute of Jamaica. A species list was established, including common names, status and occurrence.

The survey is an ongoing one and will concentrate, in the near future on areas of the development site which are set aside for conservation and buffer zones (not to be cleared or otherwise interfered with), as well as forest land adjacent to the site. This will provide information for an interpretation and education programme for the future occupants of the site, as well as propagation material of plants for re-introductions and landscaping. The survey carried out to date is considered as being sufficient for development and mitigation recommendations.

3 SITE LOCATION AND DESCRIPTION

The proposed site consists of 59 acres on Long Mountain, south of and immediately adjacent to Beverly Hills. It is located on a former Operation Pride development site of 520 acres (of which 196 acres were initially considered for development). According to survey maps prepared in February 2000 (by Roosevelt Thompson Associates) the eastern part of the proposed site is situated on a portion of land of Mona Estate (Vol.851, Fol.77), the western part on a portion of land of Hope Estate (Vol.1003, Fol.584).

4 ECOLOGY

Long Mountain is part of a system of dry tropical forests in Jamaica which includes the Hellshire Hills, Portland Ridge, Round Hill, Brazilletto Mountain and isolated small areas along the south and north coasts. Together, they represent the largest intact dry tropical forest in the entire Caribbean. Not only are they home to many Jamaican endemic plant and animal species, but they also contain species endemic to the particular areas (e.g. *Portlandia albiflora* is a Long Mountain endemic).

As an area of high plant and animal diversity and, in parts, good quality primary and secondary forest, Long Mountain is of regional, national and local importance for research and conservation, watershed protection and cultural heritage preservation, and has great potential for education, recreation and tourism.

The proposed development site has been found to be in various stages of vegetation cover, from areas almost entirely cleared, periodically for at least the past several decades, to virtually intact primary forest with its entire range of biological diversity.

There is evidence of **selective tree felling** dating back several years, possibly decades. Dead tree stumps of *Tabebuia, Coccoloba, Sideroxylon, Brya* and other hardwood species can be found almost everywhere, even in relatively intact forest. The trees were cut for charcoal burning and in earlier years possibly for posts and construction props. The fact that they are dead can be attributed to periodic **forest fires** caused by careless coal burning and land clearing for cultivation, and improper coppicing (too low). Surviving stumps have re-sprouted and have grown back to trees of 4 to 10 m, now appearing between the larger softwood species which attain hights of 15 to 20 m.

Periodic and localised **cultivation** has been going on until very recently, but must also be considered as dating back to as far as the early colonial times and possibly the pre-Columbian era. Small and large stone heaps and rows of stones and rocks can be found in parts of the forest. Taino presence on Long Mountain is evident in middens of various sizes (They contain sea shells, pottery sherds, cooking stones and bruins). One small midden has been found on the site.

Apart from large areas surrounding the development site, there are several small areas on the site which have relatively **intact vegetation cover** including a variety of medium size and **large trees**. The developer has already marked many large trees to be protected and, on the recommendation of the consultant, has set aside conservation areas of a total of 11 acres. An area of approximately 6 acres will be made accessible and interpreted for the occupants of the development.

The consultant has observed a variety of **birds** on the site, due to the presence of many mature trees, which are important for feeding and resting, and the surrounding intact woodlands. The constant presence of several species of pigeons and warblers is obvious. The 3 species of hummingbirds expected in this forest, the Stripe-headed Tanager, Mangrove Cuckoo and both, Red-tailed Hawk and Osprey (resting in large trees) have been sighted during the botanical survey.

BOTANY

Ninety species of mostly woody plants, trees, shrubs and some large monocots have been identified (see list below). Of these, **15 species are Jamaican endemics**, one of which is endemic to Long Mountain (***Portlandia albiflora***).

This survey treats approximately the double amount of species of the one tabled in the above mentioned EIA, although it concentrates almost entirely on trees, shrubs and large monocots (few herbaceous species and no grasses nor pteridophytes).

The consultant discovered a new location – Long Mountain – of a rare endemic tree, ***Bursera aromatica***, luckily before implementation of the development and in an area set aside for conservation. *Bursera aromatica* has been known so far only from a few small populations in western Jamaica. It is a large, elegant and indeed beautiful tree, and four specimens can be seen in the woodland near the main entrance.

The third rare plant (one specimen) found on the site is the endemic ***Randia aculeata* var. *jamaicensis***. The very rare endemic ***Jacaima costata***, only known from two localities, one of which is Long Mountain, has not yet been found. It may not be present on the site.

[Non of these species have been included in the above mentioned EIA. On the other hand, the species cited as rare and endemic in that EIA are in fact neither rare nor endemic; all are quite common.]

The **dominant large trees** on the site are *Bursera simaruba*, the endemic *Bursera lunanii* (Red Birch and Black Birch respectively) and *Metopium brownii* (Burn Wood), all soft wood species. Several hard wood species are growing again in this area (due to the decline in charcoal burning) and are common: *Tabebuia heterophylla* (White Cedar or Poui), *Sideroxylon salicifolia* (White Bullet), *Cordia gerascanthus* (Spanish Elm), *Brya ebenus* (West Indian Ebony) and several species of *Coccoloba* (Mountain Grape).

Other common species are *Tecoma stans*, *Croton linearis*, *Euphorbia nudiflora*, *Bauhinia divaricata*, the endemic and spectacular parasite *Psittacanthus claviceps*, and the large monocots *Agave sobolifera* (May Pole), *Thrinax parviflora* (Broom Thatch Palm) – both endemic – and several species of *Tillandsia*.

Two species of cacti, both climbing, produce spectacular large flowers and one of them excellent edible fruits (*Hylocereus triangularis*); the other species (*Selenicereus grandiflorus*), a common occurrence on rocks and large trees, is incidentally the most popular cactus in northern botanic gardens (where the flowering of the Queen-of-the-Night is cause for annual open-night cocktail parties in the conservatories).

Of particular interest in the context of a housing development must be the fact that several of these native, endemic and even the rare species are also good ornamental plants **suitable for landscaping**. 30 species have so far been identified for this purpose. It is therefore proposed that vegetative material and seeds of species of *Bursera*, *Sideroxylon*, *Tabebuia*, *Brya*, *Bauhinia*, *Cordia*, *Croton*, *Agave*, *Thrinax*, the rare and endemic *Portlandia albiflora* and possibly others be collected and propagated for use in landscaping of the site.

6 RECOMMENDATIONS

In view of the national and regional importance of the Long Mountain dry tropical forest as a natural and cultural heritage site, several mitigation measures are recommended for the proposed housing development:

6.1 **As many large trees as possible should be preserved**, ideally in groups. These trees are several decades old. They will act as wind breaks in case of a hurricane (most native trees are hurricane resistant, most exotics are not). They also provide shade, a pleasant microclimate and beauty for humans, and shelter and food for birds.

6.2 **Trees of a trunk size down to wrist size** (ca. 5 to 7 cm) should also be preserved, wherever possible. They are between 5 and 15 years old and are **the next generation of large trees**.

6.3 **Conservation areas and buffer zones** should be set aside, where not only large and smaller size trees are preserved, but where the entire understory must be left intact as well. This is where birds and other animals nest and reproduce.

6.4 Generally, it is recommended to **preserve rock and soil formations** (including their vegetation) in as many areas as possible – including future private gardens. Good gardens on Long Mountain will always be rock gardens, and the native plants are best adapted to this particular geology. Top soil can be added for kitchen gardens and lawns where necessary. This mitigation measure will also **minimise potential hydrological problems** such as drainage. The less compacting, asphalt and concrete the better.

6.5 At least 50% of the **plants used for landscaping should be Long Mountain natives and endemics**. Only non-invasive exotic species should be allowed for landscaping and in private gardens. The fact that *Portlandia albiflora* can be grown and established relatively easily and could be extensively used for landscaping, would amount to **re-introduction and introduction of a rare endemic species** allowing it not only to survive, but to increase its population and its genetic diversity. Over all, the use for landscaping of native and endemic plant species from the surrounding forest would contribute to its biological diversity.

6.6 Property owners and occupants of the housing development should be **informed about the importance of biodiversity conservation** inside and outside the development area. The conservation areas should be interpreted. The fact that names of native and endemic Long Mountain plants have been chosen by the developers for the street names is a good start in raising the awareness of the future occupants.

6.7 During construction, **work crews must be sensitized** to the importance of preservation of trees, other vegetation and wildlife. Conservation areas within the site, buffer zones and surrounding woodlands are not to be interfered with. The workers should also be informed of the possibility of encountering Taino middens which would be indicated by the presence of sea shells. Any observations should be reported to management.

SECTION 3:

Landscaping

On the basis of the botanical survey and from ecological observations on the site, the consultant **recommends approval of the project**, under the following two conditions:

1 that the **above mitigation measures be implemented**.

2 that **steps be taken by Government to assess the entire remaining forest lands of Long Mountain for their natural and cultural heritage potential** and that **a comprehensive development plan be produced including areas for conservation and recreation**.

7 LONG MOUNTAIN LIST OF TREES, SHRUBS AND OTHER PLANTS

7.1 *MONOCOTYLEDONES*

Commelinaceae				
Rhoeo spathacea	Oyster Plant, Moses-in-the-Bulrushes		common 1)	A 2)
Bromeliaceae				
Tillandsia recurvata	Old Man's Beard	3)	common	A
Tillandsia balbisiana			common	F
Tillandsia sp.				F
Liliaceae				
Aloe vera	Sinkle Bible	introd.		O
Sansevieria metallica	Bowstring Hemp	introd.		O
Arecaceae				
Thrinax parviflora	Broom Thatch, Thatch Pole	**endemic**	very common	F
Agavaceae				
Agave sobolifera	Coratoe, May Pole	**endemic**	locally abundant	D
Orchidaceae				
Broughtonia sanguinea		**endemic**	common	R

7.2 *DICOTYLEDONES*

Moraceae			
Chlorophora tinctoria	Fustic Tree	common	O
Ficus sp.			O

Loranthaceae				
Psittacanthus claviceps	Godbush, Mistletoe	**endemic**	common	F
Polygonaceae				
Coccoloba krugii	Mountain Grape		common	F
Coccoloba tenuifolia			common	F
Coccoloba sp.				O
Nyctaginaceae				
Pisonia aculeata	Cockspur, Fingrigo, Wait-a-Bit		common	A
Cactaceae				
Hylocereus triangularis	God Okra, Prickle With	**endemic**	locally common	F
Pilosocereus swartzii		**endemic**	locally common	O
Selenicereus grandiflorus	Queen-of-the-Night		common	F
Canellaceae				
Canella winterana	Canella, Wild Cinnamon		common	F
Clusiaceae				
Clusia flava	Card Gum, Tar Pot		common	O
Capparaceae				
Capparis ferruginea	Mustard Shrub		common	F
Capparis cynophallophora	Black Willow		common	F
Caesalpiniaceae				
Bauhinia divaricata	Bull Hoof, Moco John		common	A
Cassia emarginata	Senna Tree, Yellow Candle Wood		common	F
Haematoxylum campechianum	Logwood	introd.		F
Peltophorum linnaei	Braziletto		locally common	O
Mimosaceae				
Acacia macracantha	Park Nut		locally common	F
Albizia lebbeck	Woman's Tongue	introd.		O
Leucaena leucocephala	Lead Tree		common	A
Mimosa pudica	Shame Lady		common	F
Papilionaceae				
Brya ebenus	West Indian Ebony		locally common	F
Galactia pendula		**endemic**	common	O
Piscidia piscipula	Dogwood		common	A
Erythroxylaceae				
Erythroxylum areolatum	Coca Shrub		common	O
Rutaceae				
Amyris elemifera	Torchwood		common	F
Spathelia sorbifolia	Mountain Pride	**endemic**	locally common	O

Burseraceae				
Bursera aromatica	Siboney	**endemic**	**rare, local**	O
Bursera lunanii	Black Birch	**endemic**	locally common	D
Bursera simaruba	Red Birch		common	D
Euphorbiaceae				
Argythamnia candicans			common	O
Ateramnus lucida	Crab Wood		common	A
Bernardia dichotoma			common	O
Croton corylifolius			occasional	O
Croton eluteria	Cascarilla Bark		common	O
Croton humilis	Pepper Rod		common	O
Croton linearis	Rosemary		very common	D
Euphorbia cyathophora			locally common	A
Euphorbia nudiflora			locally common	A
Phyllanthus angustifolia	Seaside Laurel		common	O
Anacardiaceae				
Comocladia pinnatifolia	Maiden Plum		common	F
Mangifera indica	Mango	introd.		O
Metopium brownii	Burn Wood		common	D
Sapindaceae				
Blighia sapida	Ackee	introd.		O
Hypelate trifoliata	Ketto		common	F
Melicoccus bijugatus	Guinep	introd.		O
Celastraceae				
Schaefferia frutescens			common	O
Malvaceae				
Hibiscus clypeatus	Congo Mahoe		frequent	F
Flacourtiaceae				
Casearia nitida			locally common	O
Laetia thamnia	Scarlet Seed		common	O
Turneraceae				
Turnera ulmifolia	Ram-Goat Dashalong		common	F
Cucurbitaceae				
Momordica charantia	Wild Cerasee		very common	O
Myrtaceae				
Calyptranthes sp.				O
Eugenia maleolens			locally common	F

Sapotaceae				
Chrysophyllum oliviforme	Wild Star Apple		locally common	O
Sideroxylon salicifolia	White Bullet, White Bully		common	A
Ebenaceae				
Diospyros tetrasperma	Clamberry		common	F
Apocynaceae				
Catharanthus roseus				
var. *roseus*	Periwinkle, Ram-Goat Rose		common	F
var. *ocellatus*	Periwinkle, Ram-Goat Rose		common	F
Echites umbellata	Deadly Nightshade		common	O
Plumeria jamaicensis	Wild Frangipani	**endemic**	local	R
Urechites lutea	Nightshade, Nightsage		common	O
Boraginaceae				
Bourreria baccata		**endemic**	locally common	O
Cordia bullata		**endemic**	widespread	F
Cordia gerascanthus	Spanish Elm, Panchallon		common	A
Cordia globosa var. *humilis*	Gout Tea, Wild Sage		very common	F
Tournefortia astrotricha			frequent	O
Verbenaceae				
Citharexylum caudatum	Fiddlewood, Juniper Berry		common	O
Lantana camara	White Sage, Wild Sage		very common	F
Lantana trifolia			common	F
Solanaceae				
Capsicum baccatum	Bird Pepper		common	O
Solanum erianthum	Wild Susumber		frequent	O
Bignoniaceae				
Catalpa longissima	French Oak, Mast Wood, Yoke Wood		locally common	F
Tabebuia heterophylla	White Cedar		common	A
Tecoma stans			locally common	D
Rubiaceae				
Morinda royoc	Red Gal, Strong Back		very common	F
Portlandia albiflora	Bell Flower	**endemic**	**very local**	**R**
Psychotria sp.				O
Randia aculeata				
var. *jamaicensis*	Ink Berry, Indigo Berry	**endemic**	**rare, local**	O
Asteraceae				
Eupatorium odoratum	Christmas Bush, Jack-in-the-Bush		very common	A
Pluchea carolinensis	Wild Tobacco		common	F

EXECUTIVE SUMMARY

Notes: 1) National occurrence, following CD Adams, 1972. These plants are only common, locally common etc. as long as their habitats are intact. Many forests and woodlands have been disturbed and reduced in size in the past 30 years.

2) Site occurrence: **D**=dominant, **A**=abundant, **F**=frequent, **O**=occasional, **R**=rare

3) All species other than endemic or introduced are native.

LANDSCAPING
LONG MOUNTAIN COUNTRY CLUB

Andreas Oberli, Project Manager of the National Arboretum Foundation, was commissioned to undertake a botanical survey of the approximately sixty acres of the proposed site for the Long Mountain Housing Development. When completed, this will form part of the baseline of the impact assessment supplement, requested by the Natural Resources Conservation Authority.

The Developers have, over the past two months, benefited greatly from the vast experience of Mr. Oberli with regard to the trees and natural vegetation and with his assistance have prepared a landscaping plan. It is our objective that this will continue the natural character of the area whilst at the same time accommodating the residential needs of the community.

It is the intention of the Developer, prior to the commencement of construction, to rope off all areas for green and open spaces, which are to remain in their pristine natural state. It is further intended to identify and mark with red ribbon **all trees,** within the development site, of a trunk size five to seven centimetres and larger in an effort to preserve them where possible. Prior to the designated contractor taking possession of the construction site, the developer will scribe the proposed roads and take the land area for the buildings to formation levels so as to minimize any disturbance of the remaining vegetation.

The areas to be turfed with zoiza grass include the recreational area, the remaining lands of each housing lot on which there is no construction and the sidewalks with the inclusion of flagstones. The boulevards, avenues, streets etc. will all be lined with trees, both large and small, that presently grow naturally on the property. In fact the Developer has attempted, where possible, to name the streets and avenues after the same trees that will line them.

The feature of the proposed development is the creation of the " **Nature Reserve and Bird Sanctuary** " an area of approximately six and one half acres located more or less in the centre of the development. This will provide a natural break to the housing units that will surround it. The area in question is at present an undisturbed forested area and the only intrusion by the developer will be the creation of walking trails and the installation of wooden benches so that the residents may appreciate their environs. With the assistance of Mr. Oberli, and others, every effort will be made to encourage the return of the many species of birds. This will be enhanced by the general planting of additional native and endemic trees throughout the entire development.

The remaining five acres for green and open spaces are all to remain undisturbed and natural areas.

LIST OF LANDSCAPE TREES AND SHRUBS
LONG MOUNTAIN COUNTRY CLUB

A. BULL HOOF – MORINDA ROYOC

B. WEST INDIAN EBONY – BRYA EBENUS

C. TECOMA – TECOMA STANS

D. BROOM THATCH PALM – THRINAX PARVIFLORA

E. SPANISH ELM – CORDIA GERASCANTHUS

F. AS ABOVE

G. FRENCH OAK – CATALPA LONGISSIMA

I. DOGWOOD – PISCIDIA PISCIPULA
BURNWOOD – METOPIUM BROWNII
WHITE CEDAR/POUI – TABEBUIA HETEROPHYLLA

J. RED BIRCH – BURSERA SIMARUBA

K. BLACK BIRCH – BURSERA LUNANII

L. PORTLANDIA – PORTLANDIA ALBIFLORA

APPENDIX 2:

List of Drawings

APPENDIX 1:

Letter from the Natutal Resources Conservation Authority (NRCA)

CONSERVATION AUTHORITY

10 Caledonia Avenue, Kingston 5, Jamaica W.I.
Tel: (876) 754-7543, 754-7544, 754-7547, 754-7548, 754-7549, 754-7550 Fax: (876) 754-7595, 754-7596
E-mail: nrca@infochan.com TOLL FREE HELP-LINE: 1-888-991-5005 Web Site: http://www.nrca.org

Ref. No.: 41/2/S3

5/05/2000

Mr. Robert Cartade
Managing Director
Selective Homes Development Limited
8 Constant Spring Road
Kingston 10

Dear Mr. Cartade

Re: Long Mountain Housing Development –St. Andrew

With reference to your application for Environmental Permit dated April 17, 2000, please be advised that subsequent to an inspection of the development site done April 18, 2000 and after detail review of the Permit Information Form, and the Environmental Impact Assessment report done by Call Associates Ltd. for the National Water Commission submitted with the application, it has been decided that additional **Environmental Impact Assessment information** is necessary to complete the processing of the application.

The report should provide detail information on the following issues

1. Sewerage treatment and disposal systems –outlining in detail, mitigation measures for any related environmental impacts on the Mona Reservoir, surface and ground water systems.

2. Impact of drainage/ increased runoff on and off site especially on the adjoining areas (Mountain view and Beverly Hills community)

3. Impact of the development on Groundwater resources

4. Method of excavation for building foundations, sewer pipes, and road alignment and resultant impacts and mitigation/ taking in consideration a stipulated condition of no blasting decided at the meeting at the Office of the Prime Minister.

5. Provision of water for the development

6. Road alignment and site clearance plans with resultant environmental impacts and mitigation measures.

7. Landscaping proposals for the site

In addition to the above information, while we are in possession of the preliminary development plans, final plans should be submitted as part of the application.

Please be reminded that we will be unable to further process the application until the requested information is submitted.

Yours sincerely

L Jones
for Executive Director